Arduino-Based Remote-Controlled Robotic Arm with Recording and Repeating Capabilities

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Abstract

Robotic arms are intensively utilized for various industrial applications such as assembly lines. They can also be used to perform operations similar to human arms to accomplish tasks under hazardous environment. In this poster, an Arduino-based infrared (IR) remote-controlled robotic arm which can record and repeat a sequence of movements is proposed. It utilizes servo-motors, which have integrated gears and a shaft that can be precisely controlled to change the position of objects, to rotate and move arms and legs of robots. By setting the angle value for each motor's shaft using input from the IR transmitter located within 80cm from receiver, it can change the position of corresponding links of the arm. When robotic arm is in the desired position, corresponding IR remote button can be pressed to record the angles of all motors with LED lights indicating the number of saved positions. Up to five position savings can be recorded and repeated in a loop so that the robotic arm can be taught to perform certain functions as needed. The Arduino-based smart robotic arm is implemented and it is verified to be able to perform recording and repeating functions as designed. More complicated movements can be programmed so that the robotic arm can be used to perform required operations for potential industrial applications.

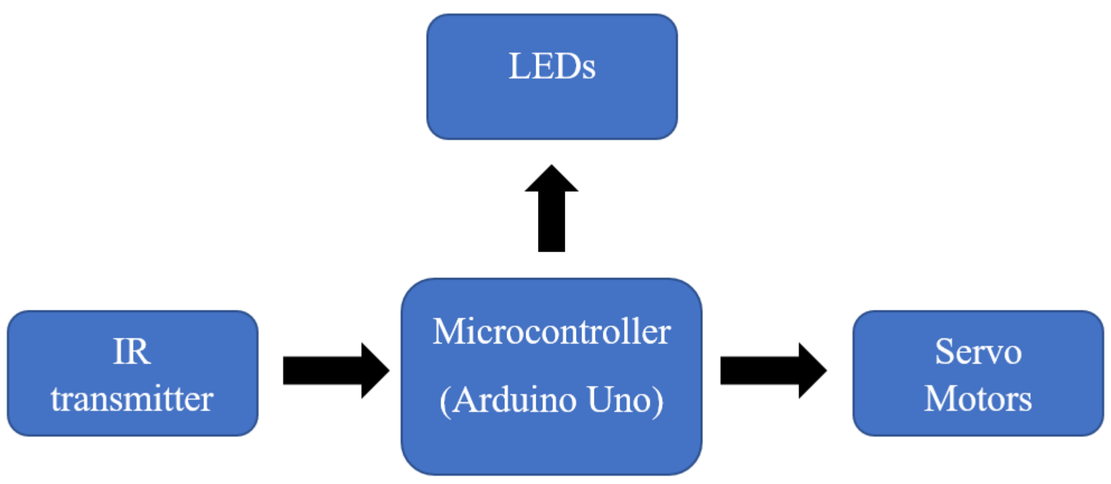
Introduction

The robotic arm is a technical device, that consists of the number of components, which are connected to each other using servo motors. The robotic manipulator can perform variety of simple tasks, such as grabbing and moving objects from one position to another. The robotic arm, according to the way it is controlled, belongs to one of the two subtypes: devices, which require human involvement to perform their task or autonomous ones. Autonomous robotic arms are extensively utilized for assembly lines. Such usage of robotic manipulators takes human errors out of equation and leads to the improvement in the quality and complexity of production. The robotic arms are also used for accomplishing tasks in the unreachable or dangerous conditions for humans, including but not limiting to the radioactive environment and space exploration. First models of robotic arms didn't include any sensors and were expected to do only one specific task. However, throughout the time simple manipulators have become complex devices, which can analyze the environment and make decisions based on the collected data. The simplest devices, used in the modern industry, have two or three servo motors, serving as links for the arm parts, however increase in the complexity of tasks requires arm to have higher number of degrees of freedom. Even though during the last decade prices on robotic arms became more accessible, industrial robots we see in the market are with high speed, accuracy, which cause heavy expenses. This project can serve as starting point for beginners to assemble and program low cost robotic arm, which can be controlled remotely as well as taught tasks by saving selected positions of the arm and then autonomously repeating task until new one is taught.

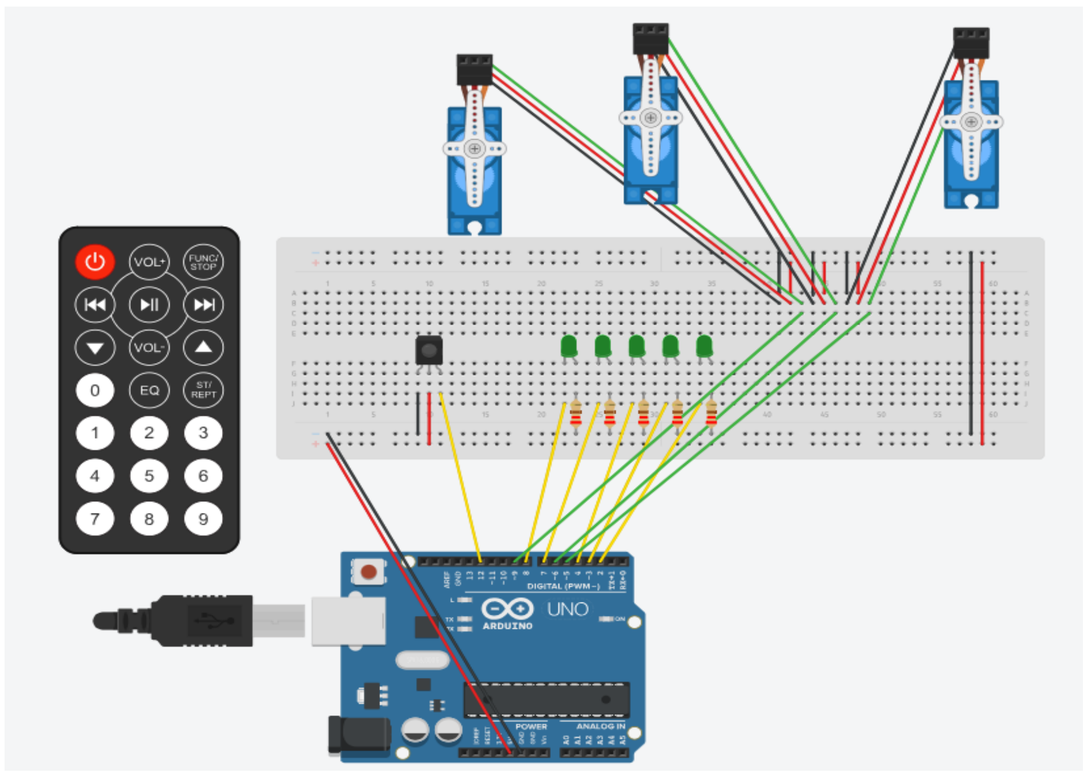
Device Fabrication & Components

1. Arduino microcontroller Uno
2. Three 9G Servo motors
3. IR Remote
4. Five Basic LEDs
5. Five Resistors (220 Ohm)
6. 10uF 50v Capacitor
7. Jumper Wires
8. USB Cable
9. Any available firm material for the shoulder, elbow and wrist

Block Diagram

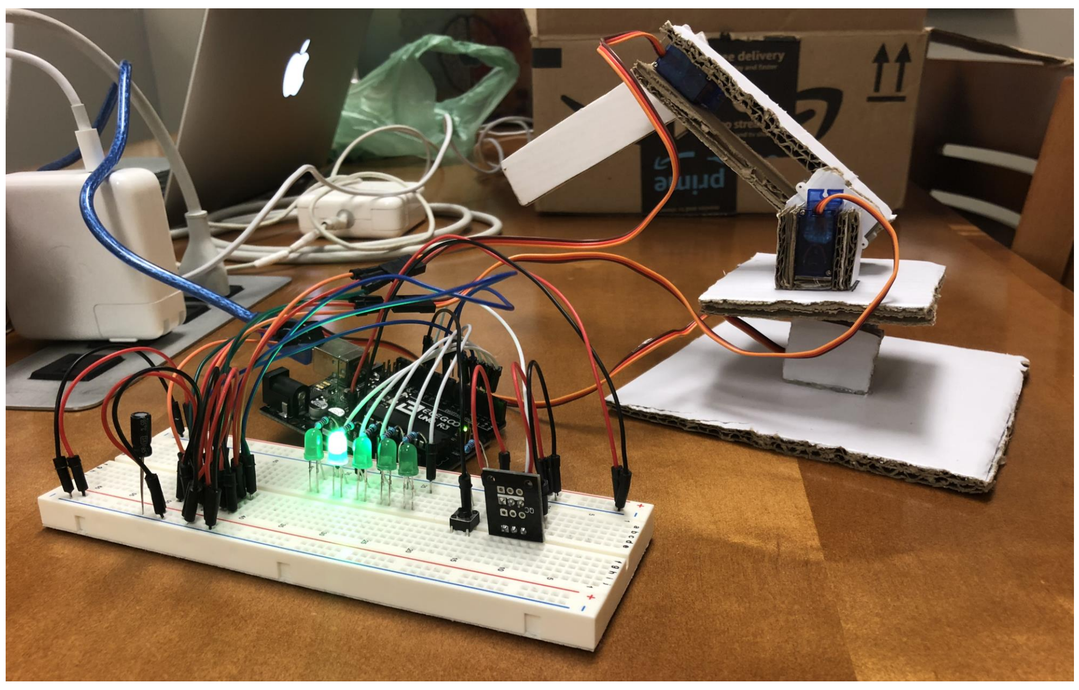


Schematics



Results & Discussion

The robotic arm, assembled using above-mentioned schema, was programmed using Arduino IDE in the way that pressing the buttons of IR transmitter cause arm to performs actions. Usually educational Arduino projects use unique potentiometers for controlling each of servo motors, but we decided to utilize IR remote, since one IR transmitter can sequentially control movements of all servos, and unlike the potentiometer, IR transmitter doesn't require human to be right next to the robotic arm to give the input. Even using our simple remote device, we can input the data from the IR transmitter located within 80cm from receiver. Each button on IR transmitter has unique hex number that is further used in our program to differentiate between buttons. Some buttons define the position of servo motor by setting its angle, other switch between three servos and after all servos' positions are set, button that is responsible for saving the total arm position can be pressed. Once pressed, LED light of corresponding number of recorded position will turn on. Number of luminous lights indicate the total amount of saved arm positions. In our project we can save up to five positions of the arm, however this number can be changed though minor code modifications. Once all positions are saved, another button is pressed, which cause all saved positions to be repeated autonomously one after another over and over again, until we decide to teach the robotic arm a new task.



Conclusions and Future Advancements

In this project Arduino-based remote-controlled robotic arm with recording and repeating capabilities was designed and implemented. It performs its initial function to autonomously repeat task using sequence of formerly recorded positions. However, if precision is required, micro servos with higher quality as well as power supply for them is required, since in our system we sometimes observed jittering of motors. In the future such robotic arm can be modified by adding more degrees of freedom, for instance gripper to be able to pick and move objects, along with supplying the arm with various sensors, such infrared sensors to detect objects or other ones to collect needed data. Such arm, equipped with sensors, power supply and more powerful servos could be used for the large range of applications starting with serving as autonomous industrial manipulator to collecting samples on Mars.